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Aviation Tactical Lightning Avoidance System for Weather-Smart Airport Operation

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Aircraft initiated or intercepted lightning is one of the heaviest issues for civilian flights in Japan. Although several accidents have been reported many years ago, it is currently much less possible that lightning strikes cause fatal aircraft accidents due to both of certifications of aircraft design for lightning strikes and many of weather supports for aircraft operation. However, hundreds of lightning strikes to aircrafts were still reported in each recent year in Japan, and airlines have been forced to delay or cancel most of those flights and to cost millions of yen for repair. Especially in the coastal area of the Sea of Japan, winter lightning often gives heavy damages to aircrafts. Though flight safety is secured even with such heavy damages by winter lightning, it is necessary to take much more cost and time to repair after landing compared with normal summer lightning.

As is well known in aviation weather field, it is significant for actual aircraft operation that observed meteorological parameters are converted to decision-making information. Otherwise, pilots, controllers, or operators need to learn meteorology as much as weather experts, and to owe hard work load to interpret observed meteorological data to their risk. Ideally, it is desired to automatically provide them with predicted operation risk, for example, delay time, possibility of flight cancellation, repair cost, etc., caused by lightning as decision-making information. In order to realize products of those operation risks, high quality of weather observation is required. A high resolution radar, such as the phased array weather radar, has potential to detect thunderstorms in their early stage due to the high volume scan rate from 10 to 30 sec. A lightning mapping system, such as Broadband Observation network for Lightning and Thunderstorm (BOLT), indicates electrical structure inside clouds in concert with a co-located radar data. Aircraft sounding and real-time data downlink, especially high-frequency data provided by Secondary Surveillance Radar (SSR) mode S, gives in-situ measurements of three-dimensional profiles of wind and temperature. The in-situ wind data supports a radar to accurately estimate spatial profiles of wind speed and direction. And the in-situ temperature data can indicate altitudes of electrical charge separation.

Our research group started a research and development (R&D) of aviation tactical lightning avoidance system in this fiscal year. The final goal of this R&D is to provide airport officers with products of operation risks caused by lightning which are derived from the novel weather observation devices stated above. In the presentation, overview and progress of our R&D will be described.

Keywords: Aviation weather, Terminal weather system, Lightning